INJURY BIOMECHANICS RESEARCH
Proceedings of the Ninth International Workshop

RECONSTRUCTION OF SPATIAL TRAJECTORIES OF IMPACTED ACCIDENT SURROGATES FROM HIGH SPEED FILM DATA WITH THE AID OF AUTOMATED DIGITAL IMAGE ANALYSIS

by

Peter F. Niederer, Ph.D., F. Mesqui
Institute of Biomedical Engineering
Swiss Federal Institute of Technology
Moussonstrasse 18
CH-8044 Zurich, Switzerland

The sensitivity of motion patterns in traffic accidents to initial conditions is an important consideration in accident simulation and reconstruction. In particular, vehicle - pedestrian collisions are characterized by the property that the motion of the impacted pedestrian may be extremely unstable. High speed film analysis of simulated pedestrian impacts represents a means of establishing the sensitivity of the relevant motion patterns.

A film frame can be regarded as a 2-dimensional projection of a spatial scene. If a dynamic event is filmen concurrently by different cameras from different angles, a reconstruction of the trajectory of a marker therefore is possible, provided that:

1. The marker under consideration is visible from at least two cameras at any instant of time;
2. the films are synchronized;
3. each camera, the associated optics, as well as the image analysis system are calibrated.

In addition, in test programs involving human subjects where instrumentation is limited, film analysis should include quantitative methods in order to alow for maximal use of the available sources of information. For such purposes, however, manual film analysis is no longer feasible because of the vast data handling and computation needs.

A procedure has been developed which enables the semiautomatic determination of trajectories from high speed film data. The image analysis system

used for this purpose consists of a computer-controlled, single frame projector, a video dissector camera for image digitization and a microcomputer system equipped with a high speed random access image memory. With this system the automatic tracking of 20 targets over 300 frames takes about 2 hours. After processing the different views and subsequently reconstructing the spatial location of markers, an accuracy of approximately 4 mm is reached on each coordinate.

The application of the method to pedestrian impacts is shown, and the sensitivity of different accident configurations is discussed qualitatively. The accuracy and limitations of determining velocities and accelerations from the reconstructed trajectories are demonstrated.